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THE FUNGUS CAUSING LEAF ROT OF THE CARNATION.

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(With three Text-figures.)

IN the *Gardeners' Chronicle*, LXXXI (1927), 196 and 216, Professor Salmon and Mr W. M. Ware described a disease of border carnations to which they gave the name of Leaf Rot. The disease was apparently new to this country, but was found to be known in Holland and Germany. It is characterised by the presence on the leaves and stems of large, soft, greyish or brownish lesions, which bear numerous tiny raised pustules. The latter are the acervuli of an imperfect fungus belonging to the Hyphomycetes. Eventually the tissues attacked become completely rotted.

When observed in Holland⁽¹⁾ the fungus was described as being in habit somewhat like a *Gloeosporium*, but with spores which were two- or frequently three-celled. Hence the genera *Marssonina* and *Septogloeum* were mentioned as possibilities, but no definite determination was made. Meanwhile the fungus had already been described in Germany in a paper which was evidently not known to the Dutch pathologists. Höstermann and Laubert⁽²⁾ gave in 1921 an excellent description of a "new fungus disease of the carnation," and, owing to the peculiar characters of the fungus, erected for it a new genus which they called *Pseudodiscosia*, the species being given the name of *P. Dianthi*.

When diseased material came into the hands of Professor Salmon early in 1927, the fungus was recognised by Dr Pethybridge as being probably identical with that described in the German paper. The present authors were given an opportunity of examining a specimen, and were much interested to find that the fungus resembled very closely, particularly in the form of the conidia, the non-ptycnidial, parasitic stage of *Heteropatella Antirrhini*⁽³⁾, the cause of a destructive disease of cultivated antirrhinums. With their usual kindness, Professor Salmon and Mr Ware willingly provided material for comparison and cultural work.

It may be noted here that during the summer of 1927—a season particularly suited to this type of fungus on account of its low temperatures and heavy rainfall—the fungus was found by us to be present almost wherever sought for. Few border carnations were met with, but the fungus occurred commonly on various types of pinks, including “Mrs Sinkins,” although apparently it never did any appreciable damage to these hardier forms of *Dianthus*.

The acervuli are minute, appearing as tiny raised pustules originating beneath the cuticle of the host plant. In dry weather

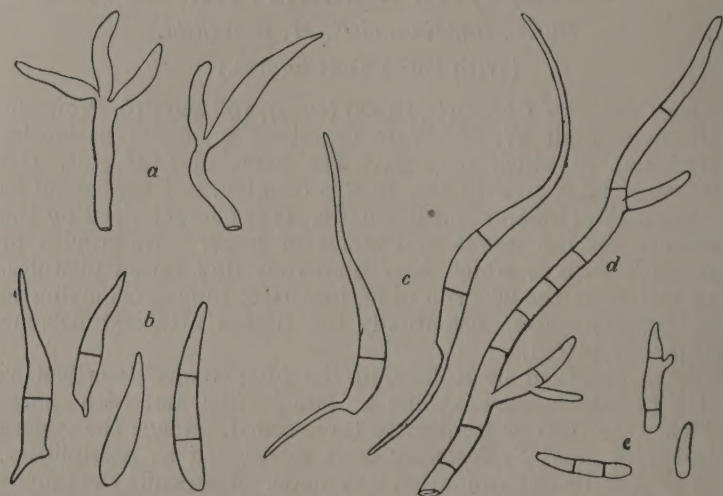


Fig. 1. *Heteropatella Dianthi*, parasitic stage. a. Conidiophores and young conidia. $\times 850$. b. Conidia as frequently found, with appendages not fully developed. $\times 850$. c. Conidia from culture of *Pseudodiscosia Dianthi* obtained from Baarn. $\times 850$. d. Mycelium of *Pseudodiscosia* in pure culture. $\times 550$. e. Conidia (primary form) found in cultures on malt agar, etc. $\times 550$.

it may be difficult to find spores, and such as occur are short, and at most only one- or two-septate, with no appendages (Fig. 1, b). In damp weather, however, conidia are formed abundantly and their final form is similar to that of the mature conidia in *Heteropatella Antirrhini*, namely, two- to three-septate, with a very long-drawn-out apex and a more abruptly attached, pedicel-like basal appendage (Fig. 1, c). As compared with the conidia of the parasitic stage of *H. Antirrhini*, those of the carnation fungus are broader (average $5\text{--}6\mu$) and the body portion is somewhat shorter (not more than 25μ long). The appendages, however, vary so much in length, and are so frequently absent, that their measurements are worth little as a

diagnostic character. Under favourable conditions the apical portion may reach 25 or 30 μ in length, and the basal a little less. It is common to find that none of the tailed spores are developed, but only small conidia of extremely variable size with no, or only one, septum. These correspond to the "primary conidia" observed in growths from spores of *H. Antirrhini* (3 p. 179), and occur also in cultures of the fungus under consideration (Fig. 1, *d, e*). Such conidia suggest the genus *Marssonina*, and it has been found that a specimen which was received at Kew in 1924 and referred to a form of *Marssonina Delastrei* was in reality this species.

Without question the fungus is the same as that described by Höstermann and Laubert (*loc. cit.*). These authors also mention the great variability of the spores and the frequent lack of appendages. In one point, however, our observations differ from the previous description. Höstermann and Laubert speak of the cells of the sporiferous layer acting as conidiophores: from their figure it would appear that they saw no differentiated conidiophores and regarded the spores as practically sessile on the basal tissue. As shown in Fig. 1, *a*, this is not the case. The conidiophores when teased out are cylindrical, 3–4 μ in diameter, and frequently branched. The point is of importance in considering

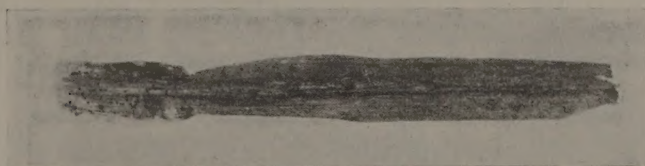


Fig. 2. Carnation Leaf showing pycnidia of *Heteropatella Dianthi* towards base. Nat. size.

the systematic position of the fungus. The German authors had evidently considered the resemblance in form between the conidia of their fungus and those of *Heteropatella*, for they remark: "*Heteropatella* differs in the swollen acervulus and branched conidiophores." The second character is not accurate: in point of fact there is no difference between the conidiophores of *Pseudodiscosia* and those of *Heteropatella*.

The original material received from Wye consisted of fairly large, old clumps of carnation, with numerous typical lesions on the green leaves. In addition, careful search on the lower, old and very rotten leaves, and on the lower portions of still living leaves revealed the presence of pycnidial fructifications of the *Heteropatella* type (Figs. 2, 3, *a*). These were similar in

shape to those of *H. Antirrhini*, but smaller, and without the *Geaster*-like arrangement of the apical lobes when open. The pycnidia were from 0.25 to 0.5 mm. in diameter, and the spores, when ripe, were extruded in dirty whitish globules. The conidia (Fig. 3, c) were of the characteristic form, and markedly curved, with long appendages. The size of the conidia was similar to that of the *Pseudodiscosia* form, namely, body $20\text{--}25\mu \times 4\text{--}6\mu$,

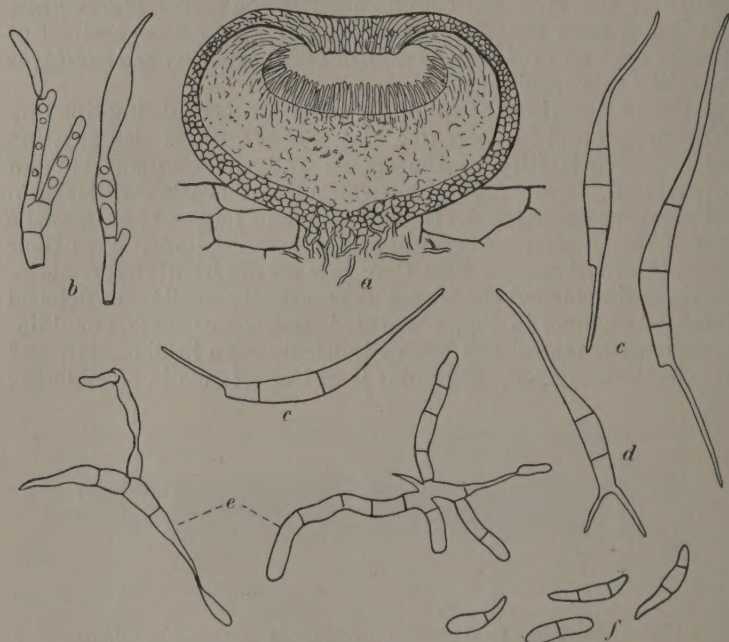


Fig. 3. *Heteropatella Dianthi*. a. Vertical section of pycnidium. More or less diagrammatic. b. Conidiophores and young conidia. $\times 850$. c. Mature spores. $\times 850$. d. Abnormal spore with two appendages at base. $\times 850$. e. Germination of spores, showing appressoria (?). $\times 850$. f. Primary conidia found in cultures on malt agar, etc. $\times 850$.

with appendages usually up to 20μ long, but occasionally reaching 30μ . On germination one or both appendages may give rise to terminal swellings suggesting appressoria (Fig. 3, e), such as were described by Höstermann and Laubert, and by Salmon and Ware, for the other (*Pseudodiscosia*) stage. The nature of these swellings is not clear; they may be due merely to hyphal growth taking place from the tips of the appendages as well as from the body of the spore. The effect, however, is characteristic for this fungus, and nothing similar was ever observed in *H. Antirrhini*.

Single spore cultures were started both from the *Pseudodiscosia* conidia, and from conidia derived from the *Heteropatella* pycnidia. Repeated platings were made from both forms as material became available, and invariably the cultures thus obtained resembled one another in appearance and behaviour. As in *Heteropatella Antirrhini*, growth is very slow, and freshly isolated cultures tend to produce pinkish, slimy masses of small spores, which are unseptate, or one- to two-septate, and without appendages. In cultures which have been kept for some time the development of conidia ceases. The mycelium within the agar becomes dark brown or blackish, while a mat of whitish aerial mycelium is developed. When any strain has been kept *in vitro* for a considerable period the tendency not to form conidia becomes more pronounced, and the abundant mycelium may be developed at once without the intervention of the slimy, conidia-bearing stage. This was particularly so with a culture of *Pseudodiscosia Dianthi* obtained from the Centraal-bureau at Baarn. Such strains, which do not produce the preliminary slimy layer of conidia, give colonies which become greater in diameter before staling takes place, but the difference in macroscopic appearance of the cultures is not considered to indicate any important systematic difference. The dark colour of the old mycelium is another character in which this species differs from *H. Antirrhini*. A further difference lies in the fact that the extreme tailed conidia are less readily developed both in nature and in cultures. The primary conidia eventually become from one- to three-septate and pointed at each end (Figs. 1, e, 3, f), but only rarely on the media used by us was there any indication of the development of the characteristic appendages although they were abundant in the Baarn culture on oat agar (Fig. 1, c).

In no case has there been any development of pycnidia in artificial cultures of the carnation fungus.

The temperature relations are similar to those of *H. Antirrhini*. On thick malt agar plates growth is best at 19–20° C., but it is almost as good at cool laboratory temperatures of 11–16° C. At 25° C. the growth becomes thick and compact, with very little lateral extension, while at 30° C. there is no visible growth at all. The rate of growth is indicated by the fact that after one month at 19–20° C. vegetations from spores reach a diameter of only 22 mm.

Owing to the absence of pycnidial formation in cultures, it became necessary to rely more on inoculation tests for direct evidence of connection between the *Pseudodiscosia* and *Heteropatella*.

On May 13th, 1927, six varieties of healthy border carnations were sprayed with spores derived from a pure culture of *Pseudo-*

discosia Dianthi. By June 13th there were definite lesions on three of the varieties, and small doubtful spots on a fourth. Eventually, with continued cool and wet weather, most of the plants in the inoculated area became infected, although the same varieties in an uninoculated area separated by a few yards remained healthy. Early in January, 1928, pycnidia of the *Heteropatella* type were found to be present on the old leaves of the affected plants.

On March 1st, 1928, a carnation of the variety "Flesh Pink" was sprayed with a spore suspension derived from a pure culture of the *Heteropatella*. On April 11th this plant showed definite lesions with acervuli of the *Pseudodiscosia* type and the primary form of conidia.

There is therefore no doubt that *Pseudodiscosia Dianthi* is related to a species of *Heteropatella*, just as *Cercospora Antirrhini* was found to be related to *Heteropatella Antirrhini*. The *Heteropatella* on *Dianthus* appears to be distinct from other species of the genus, not only in its parasitism on *Dianthus*, but also in the small pycnidia, and in the peculiar formation of the swollen bodies at the tips of the appendages on spore germination. It may be called *Heteropatella Dianthi* sp. nov.*

The existence of two stages, both belonging to the Fungi Imperfecti, in these two species, *H. Dianthi* and *H. Antirrhini*, raises a point of nomenclature which requires a little consideration. In fungi with a pleomorphic life cycle, the International Rules state that the name to be used is that which was first given to the perfect stage. At present no perfect stage has been found for the fungi in question, and it might be argued that the generic name *Pseudodiscosia* is to be preferred as having been applied to the most conspicuous stage†. In referring to the fungus as a whole, however, it seems to us that it would be preferable to use the generic name *Heteropatella*, on the grounds that the pycnidial stage may be regarded as of more advanced

* *Heteropatella Dianthi* Buddin et Wakef. Pycnidia epiphylla, erumpentia, sparsa, 250–500 μ diametro, globoso-depressa, demum irregulariter dehiscentia, tunica fusca, molle praedita. Substantia interna albida, ex hyphis crasse tunicatis densissimeque intertextis composita. Discus conidiophorus concavus, pallidus. Conidiophora dense verticaliter disposita, filiformes, ramosa, 30–40 μ $\times$ 3–5 μ . Conidia falcata, utrinque attenuata, hyalina, plerumque 2–3 septata, 20–25 μ $\times$ 4–5 μ , apice appendiculo filiforme 12–20 (–30) μ longo praedita, basi propter appendiculum breviorum quasi pedicellata. Conidia in globulos sordide albidos emergentia.

Hab. In foliis putridis *Dianthi caryophylli*, socie *Pseudodiscosia Dianthi* Hösterm. et Laub.

† As stated in dealing with the *Antirrhinum* parasite, the authors now consider that the parasitic stage should not be referred to the genus *Cercospora*. If a generic name is required for that stage alone, then certainly *Pseudodiscosia* should be used, and the fungus called *Pseudodiscosia Antirrhini* comb. nov.

development morphologically than the Hyphomycetal stage, and still more because that generic name indicates at once the probable real affinities of the fungus, *Heteropatella* being an old and well-known genus, representing the pycnidial stage of *Heterosphaeria*. Should at any time the ascospore stage of either species be found there would be no difficulty, as the name of that stage would be the valid designation.

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